Use of Small Unmanned Aircraft to Study the Lower Arctic Troposphere

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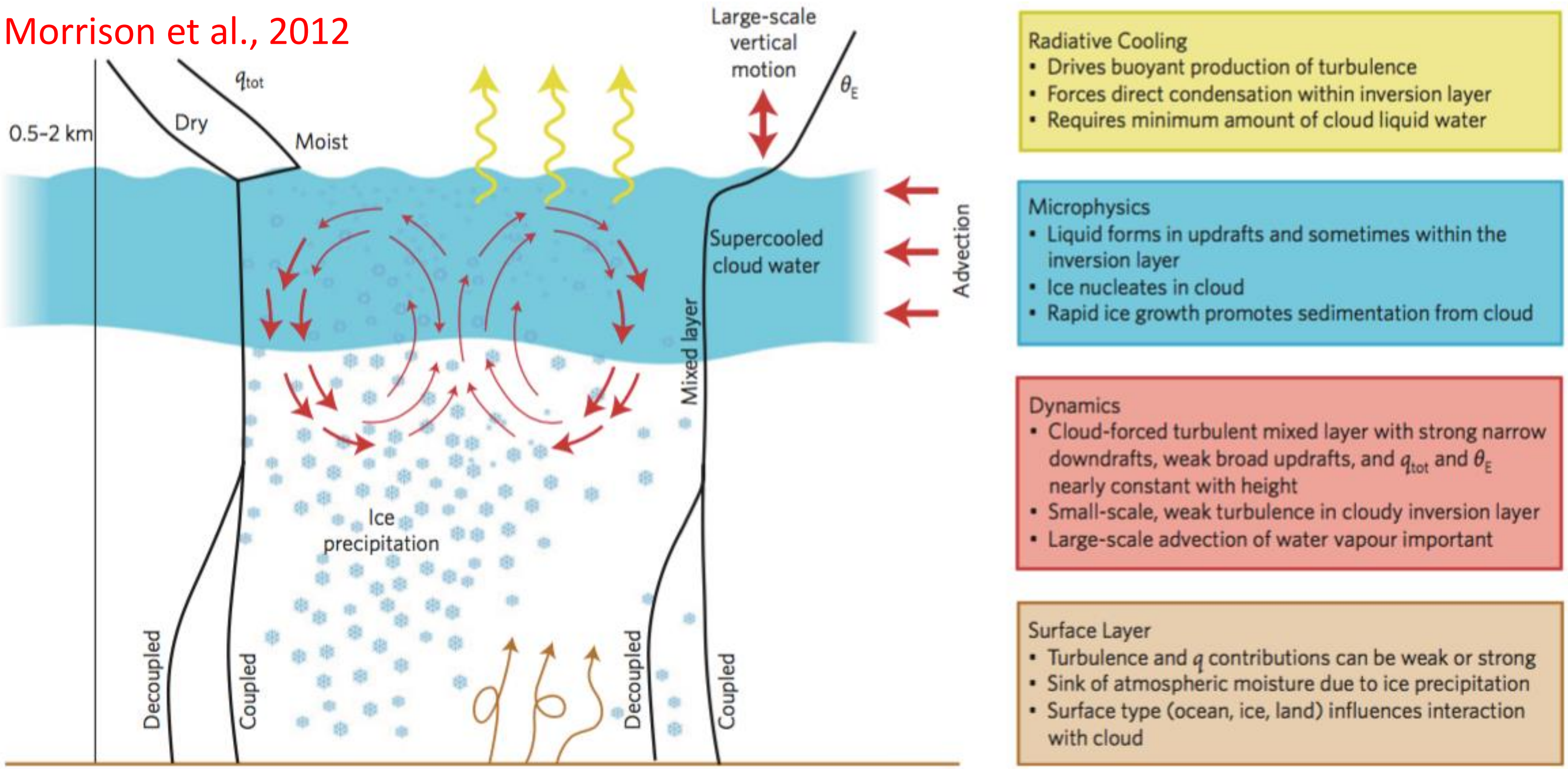
Introduction and Science Drivers

Morrison et al., 2012



To get the full story, we need new perspectives. Specifically, to develop process-level understanding and model parameterizations we need:

- Additional information on spatial variability across a variety of scales
- Frequent profiling of aerosol, thermodynamic and cloud properties
- Information over “hard-to-reach” environments, such as thin or broken sea ice and the expansive tundra

Platforms

CU DataHawk2

Description:
1 m wingspan
800 g total weight
~$850 vehicle parts cost
15-20 m s^{-1} typical airspeed
75 min flight duration (level)
~70 km range (level)
~4 km max altitude (powered)
50 m turn radius
5 m s^{-1} maximum climb rate

Measurement Capabilities
Temperature
Relative Humidity
Pressure
3D wind vector estimate
IR Surface Temperature
Location

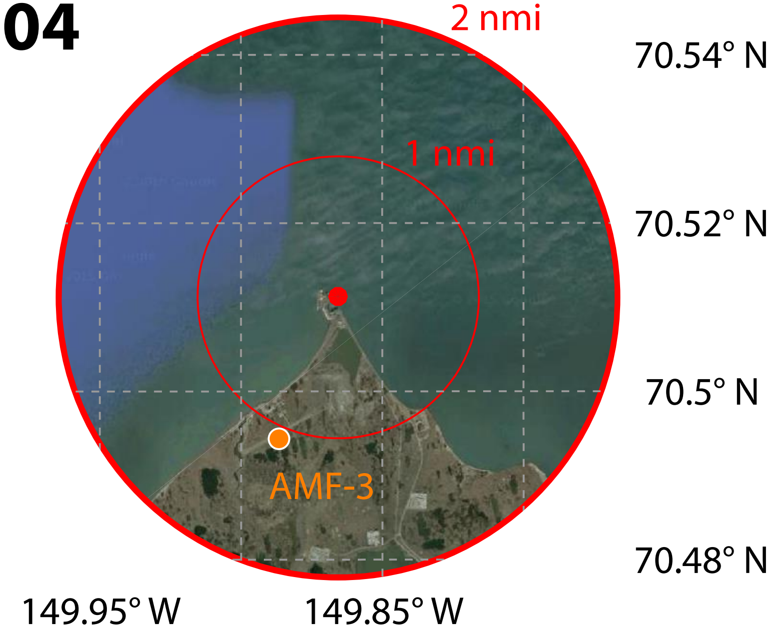
Platforms

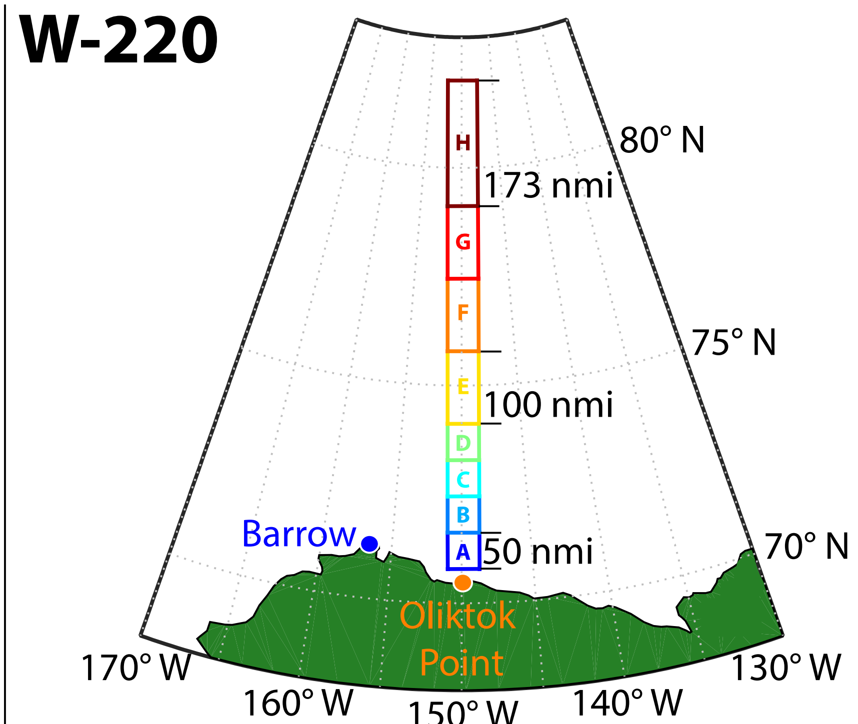
CU Pilatus

Description:
3.2 m wingspan
24 kg total weight (including payload)
25-30 m s^{-1} typical airspeed
25 min flight duration (level)

Measurement Capabilities:
Aerosol size/number
Broadband radiation
Temperature
Humidity
Pressure
Position
Wind estimate

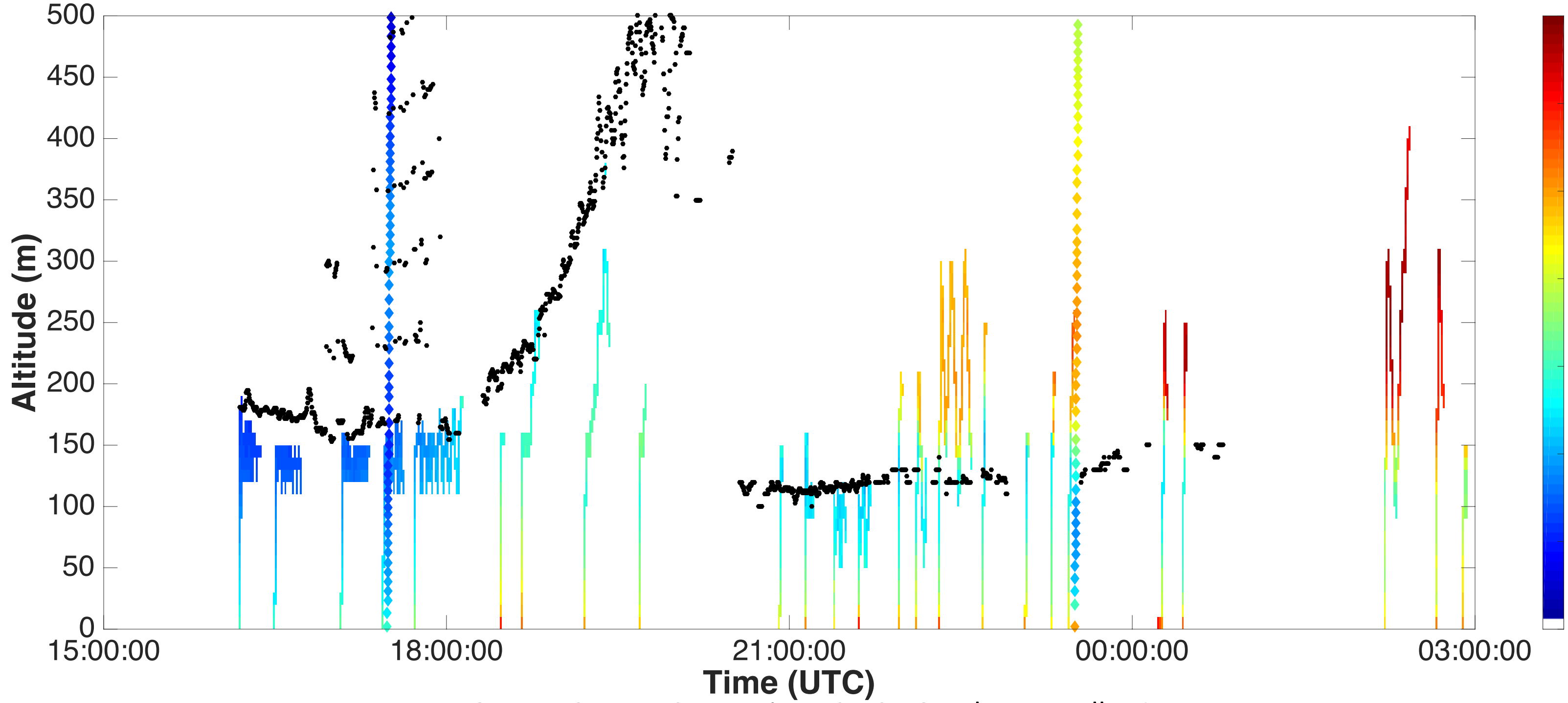
Research Site and Airspace



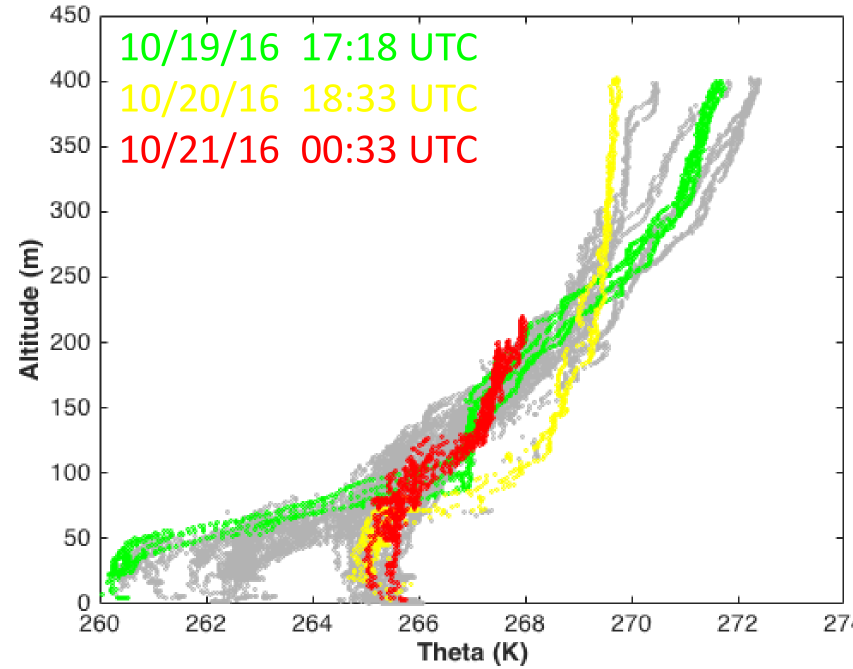


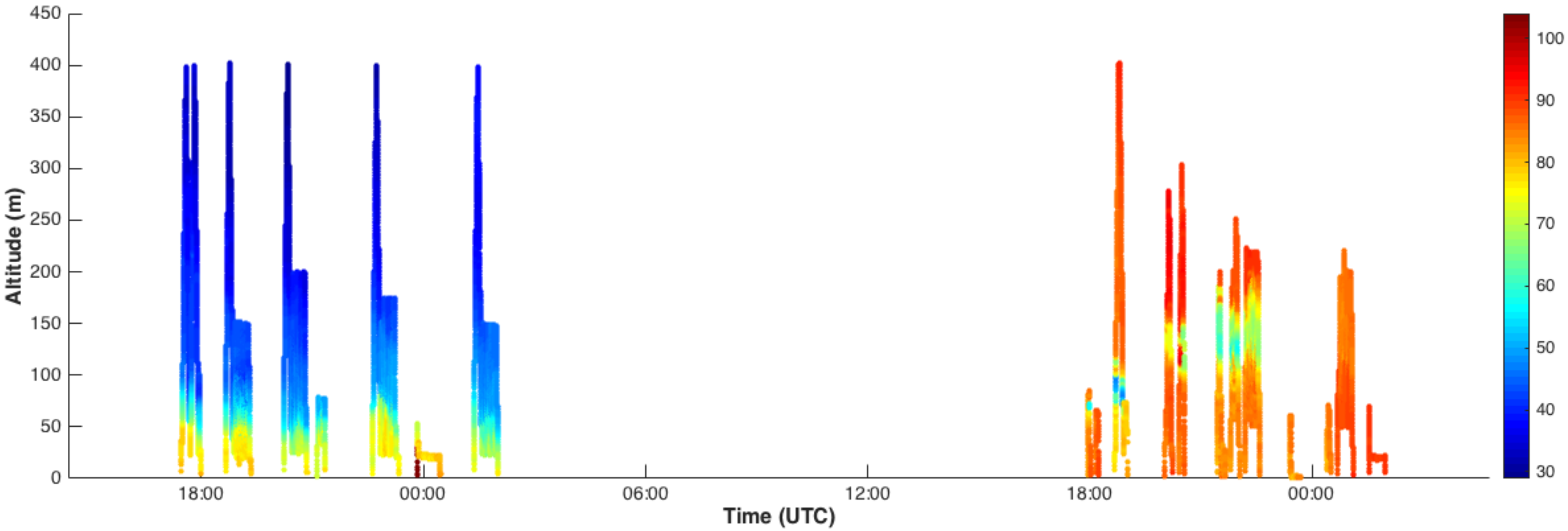
de Boer et al., 2016a

Thermodynamic Structure

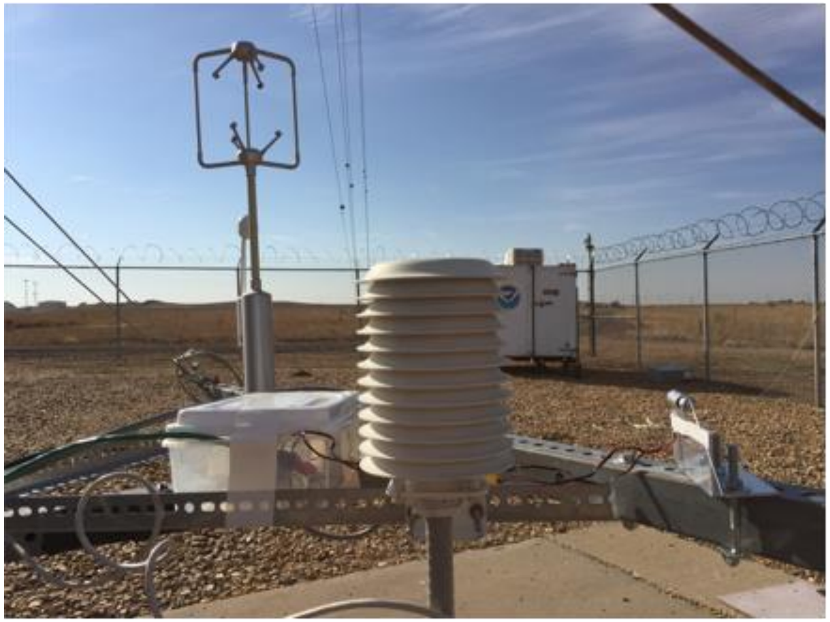


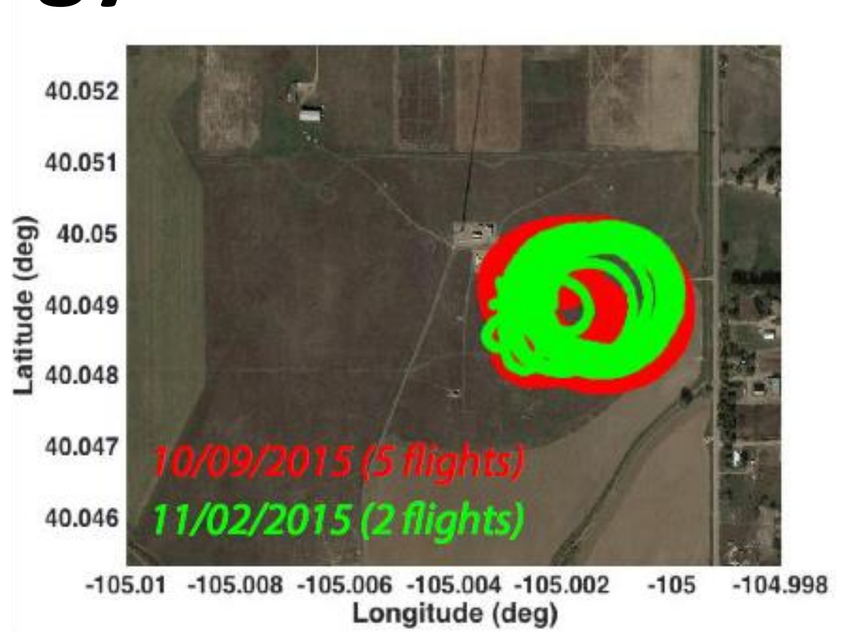
Thermodynamic Structure

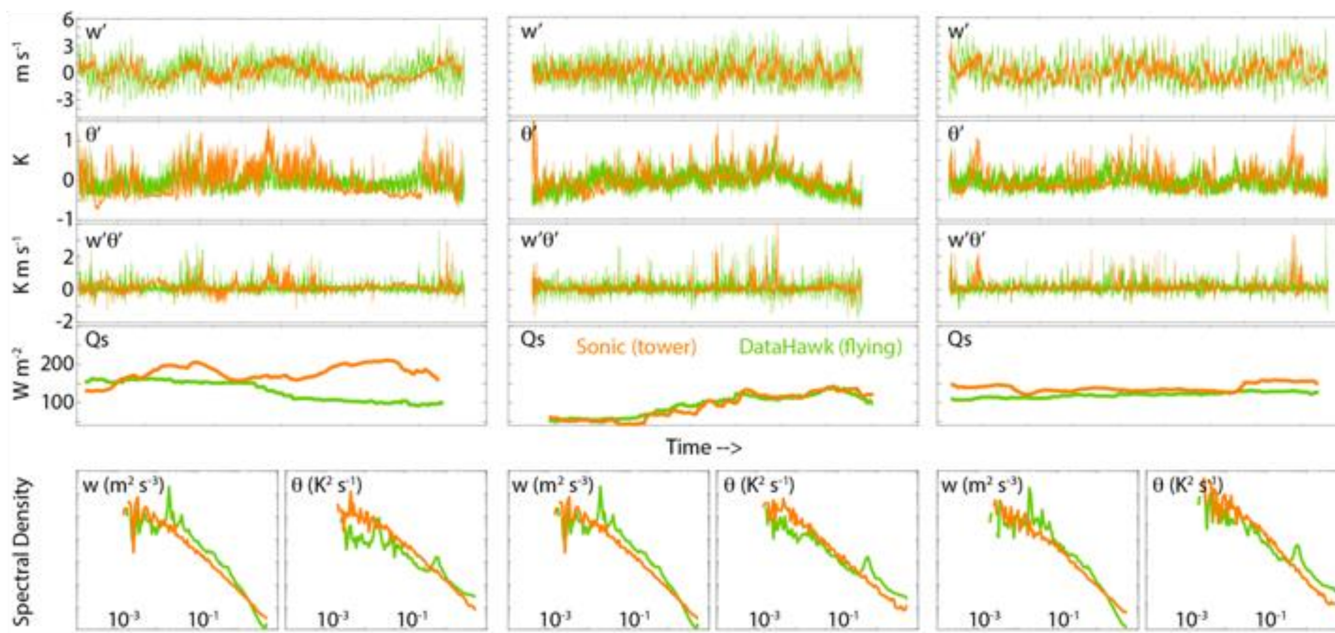




Surface Energy Fluxes



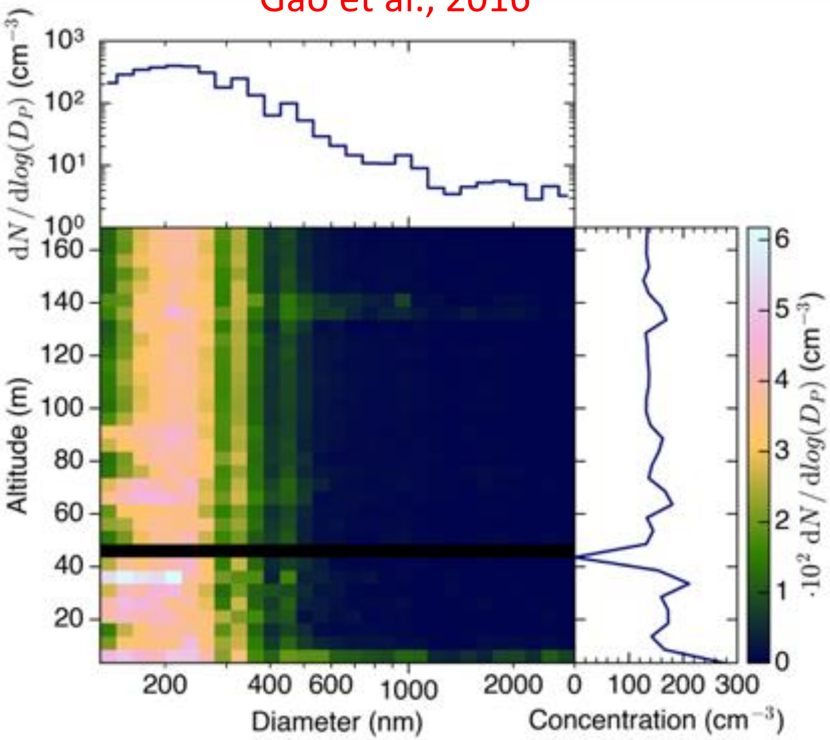




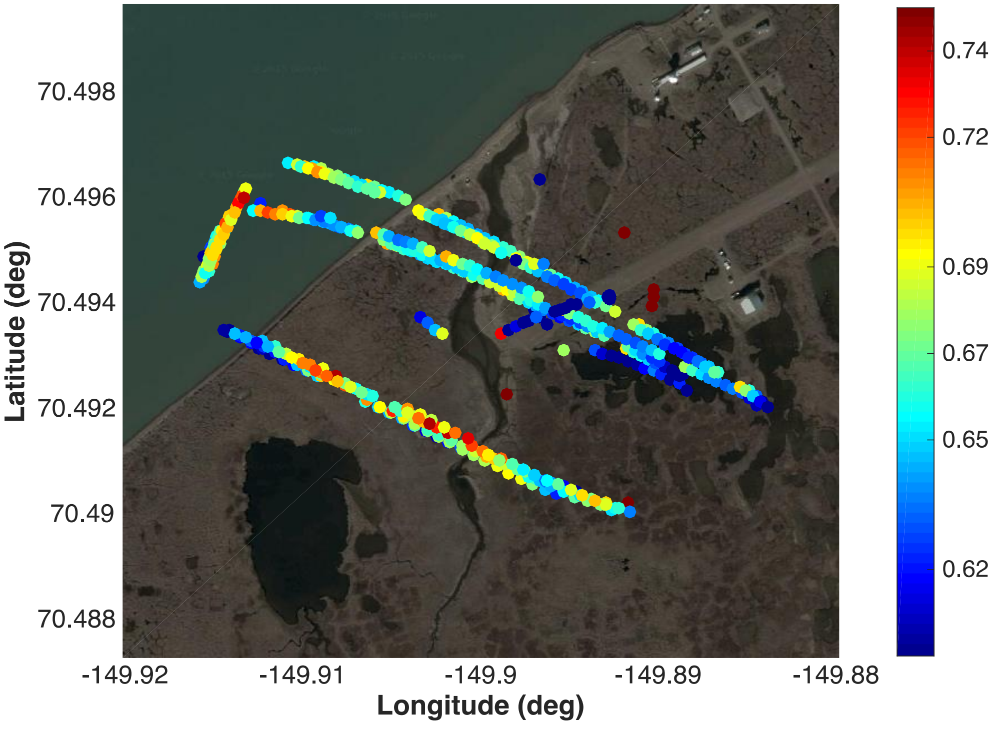
Surface Energy Fluxes

Aerosols and Radiation

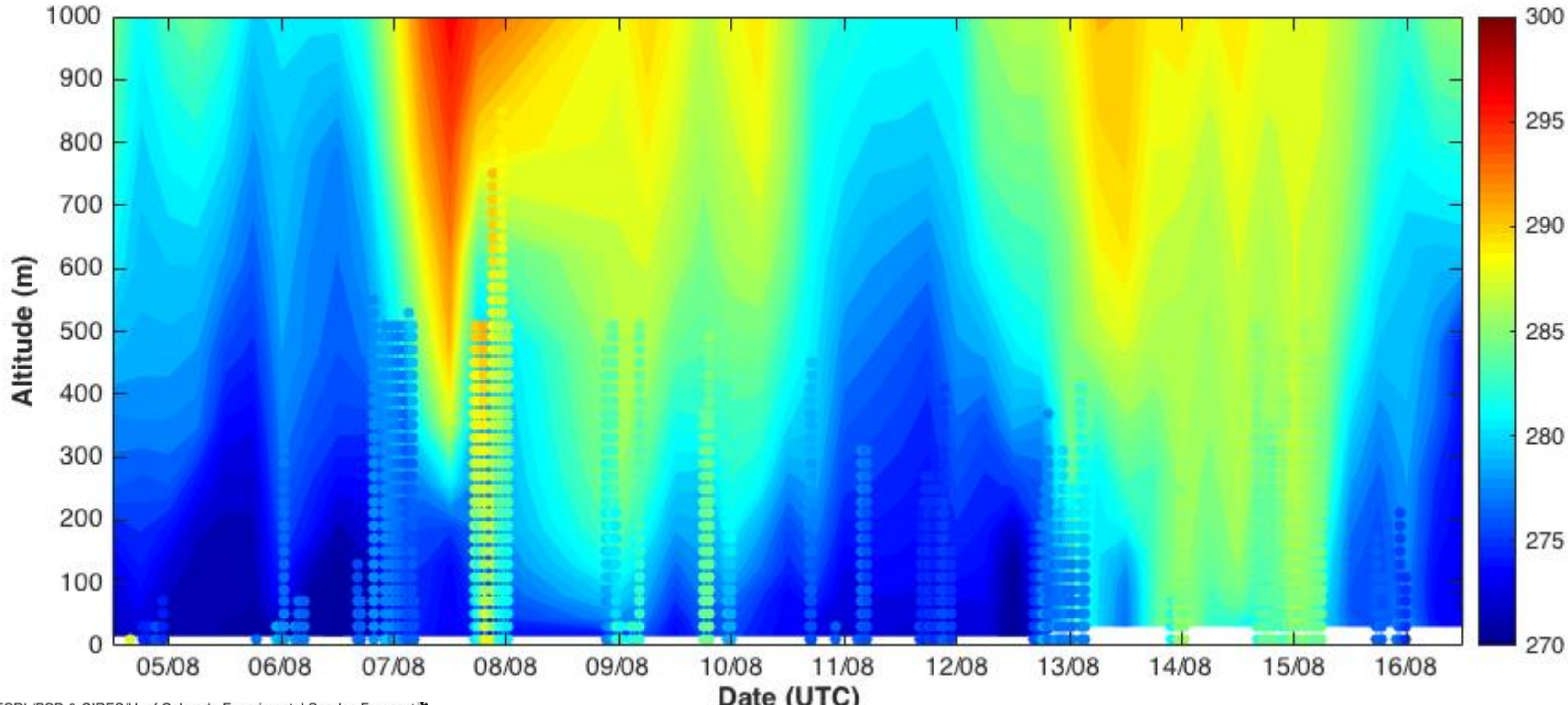
Gao et al., 2016

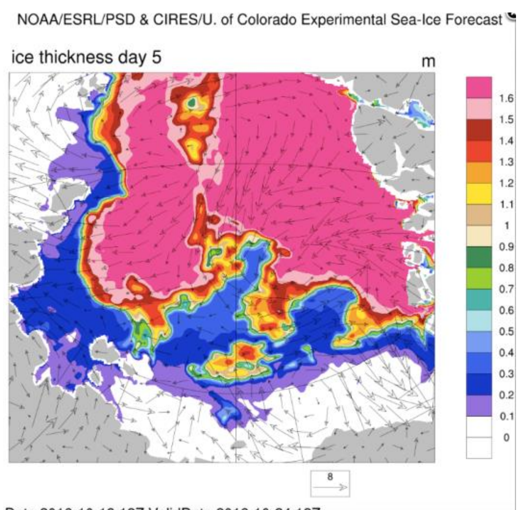


de Boer et al., 2016b



Model Evaluation and Improvement





PSD supports development of experimental sea ice forecasting tools to support Arctic decision making. This tool uses the Regional Arctic System Model (RASM) in a coupled mode to predict ice formation and melt over short to medium time scales. We are using UAS measurements as a means for validation of model performance and for collection of data to aid in parameterization development.

Summary

- We are using small unmanned aircraft to study the lower Arctic troposphere and its interaction with sea ice, tundra and ocean surfaces.
- This includes efforts to measure thermodynamic structure, cloud-relevant aerosol processes, radiation and surface state.
- These measurements are being used to evaluate and improve PSD's regional sea ice forecasting capability and develop process-level understanding of features critical to modulating energy transfer through the atmosphere.